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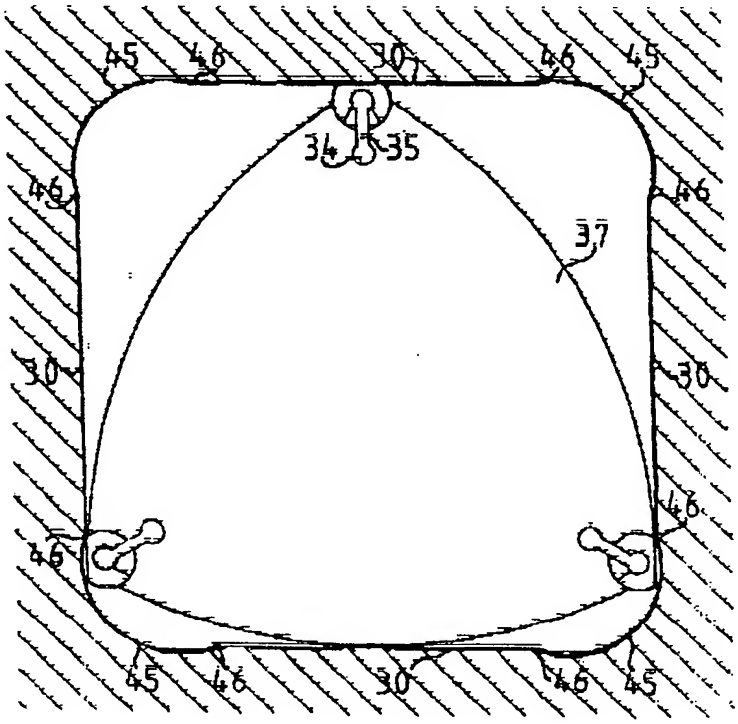
(54) Title: ROTARY PISTON MACHINE

(57) Abstract

Rotary Piston Machine of the type that consists of an in cross section square inner area (1) with therein fitting a rotary piston which in cross section has the perimeter of a fluently closed curve of constant width with three axes of symmetry (37). In the square inner area the four angles are substituted by four cylindrical inner surfaces of more than 90 degrees (45), what means that a cross section of the square housing the continuous inner surfaces exposes with totally 8 discontinuities, (see fig.0), (46). The three ribs of the rotary piston are substituted by three around their longitudinal axis over an angle of 60 degrees rotatable sealing elements (40), each provided with a levelling (44) over the full length. On rotating the rotary piston the sealing elements can pass through the said discontinuities fluently. Centrifugal forces pushing outwards the sealing elements will be neutralized by special links (34/35).



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Rotary Piston Machine.

The invention refers partly to an in the register of patents already known Rotary Piston Machine, described in the Euro-patent application nr. 95902321.9-2301.
For the sake of clearness and tuning of terminology when describing the invention, first will follow a brief recapitulation of the patent description of the already existing rotary piston machine.

The rotary piston machine is characterised by the application of an enclosing body (see fig. 1), with four flat inner surfaces (1) of equal width and equal length, forming an in cross section square inner area, with a rotary piston (2), which in cross section has the perimeter of a fluently closed curve of constant width R with three axes of symmetry.
Such curves occur by drawing from the centerpoints of three equal and in aequilateral triangel relation placed circles (see fig. 1), hereafter called angle circles (7), tangent circle curves (8) on the back of the two opposite angle circles.
The movements of the rotary piston have been combined from a rotation around the own central axis (Z), plus a rotation of the central axis around the longitudinal central axis (M) of the square inner area, in a rotation direction which is opposite to the rotation direction of the rotary piston.
During a complete revolution of the rotary piston, the own central axis Z rotates three times around the longitudinal central axis M.
Because of its constant width the rotary piston in the square inner area will touch in every position each of the four inner area surfaces along a straight line in the longitudinal direction, called hereafter "touching straight".
During rotation of the rotary piston the touching straights will shift parallel over the inner chamber surfaces, whereby the touching straights with the ribs of the rotary piston move in the direction of rotation of the rotary piston and the touching straights with the flanks of the rotary piston move opposite the rotation direction.

These to and fro motions of the four touching straights are limited to parts of the inner surfaces which are situated inside the extreme touching straights at some distance from the angle straights of the square inner area.

The angle straights of the square inner area with the adjacent strips of the inner area surfaces, which are not touched by the rotary piston, hereafter will be called "free angles" (5).

Between the four "free angles" and the rotary piston with the touching straights, moving to and fro over the inner surfaces, four working chambers separated one from the other and changing in volume (6), are being formed.

The "free angles" of the square inner area offer possibilities to fix various, for this type of machines common provisions, such as inlet and exhaust ports, with valves or slides, igniting mechanisms, heating elements, fuel injection mechanisms, etc., without hampering the free revolution of the rotary piston in the inner area.

The free angles also offer, within reasonable limitations, the possibilities of volume changes of the working chambers with any desired proportion between the largest and the smallest volume, when constructing applications of these machines.

Through affixing meshing gears to both of the parallel rotary axes of the rotary piston, one with external, the other with internal gearing, it can be achieved that during power exchange from or to the rotary piston the actual position of the rotary piston is not being determined by touching the inner area surfaces of the housing, but rather by the gearwheels, through which the rotary piston, in principle with relative small play, rotates freely inside the square housing.

An important function of a rib of a rotary piston during its track along the inner area surfaces, consists of the separation of the two working chambers on both sides of the rib, with possible mutual bigger pressure- and temperature differences.

This separation of two working chambers wil be according to

the invention realised by "angle cylinders"(7) corresponding with angle circles, hereafter called "rib-cylinders".
The part of the surface of a rib-cylinder which is positioned on the surface of the rotary piston, which is a 1/6 part (9), will hereafter be defined as "cylindrical rib".
The importance of this invention lies for the greater part in the fact that the cylindrical ribs offer excellent views to the constructor of the machine to accomplish effective separation of two working chambers on both sides of a cylindrical rib.
How the specific qualities of the cylindrical ribs of the invention can be used in different ways, in accomplishing efficient separation functions of the ribs, shall be explained in fig. 2.

Execution and working of the play sealing A1 (fig.2,detail A1). Every cylindrical rib of the rotary piston is over the full length replaced by a cylindrical boring in longitudinal direction (15), whereby the axis of the boring coincides with the axis of the rib-cylinder and whereby the diameter of the bore is equal to the diameter of the rib-cylinder.
Within two touching surfaces on both sides of the boring (16), mutually under an angle of approximate 60 degrees, all material of the rotary piston is taken away. In the gutters-hape groove with cylindrical bottom, a cylindrical rod (sealing element) (17) is being brought over the full length, with the diameter of the rib cylinder. During pressure differences on both sides of the cylindrical rod the play between rib and inner chamber surface will close off on the side of the lowest pressure.
While passing of a free angle, the cylindrical rod is being led by the shape of the free angle or by special conduction strokes (18).

Execution and working of the play sealing A2 (fig.2,detail A2).
Each cylindrical rib of the rotary piston is replaced over the full length by a cylindrical boring in the longitudinal direction (12), whereby the axis of the boring coincides with

the axis of the rib-cylinder and whereby the diameter of the boring is greater than the diameter of the rib-cylinder.
In the bore, a cylindrical rod of the same length as the bore fits in freely rotating around its length-axis, which is provided with a levelling over the entire length and to a depth on which the levelling touches the imaginary rib cylinder.
When placing the sealing element in the lengthwise boring, the levelling of the sealing element with some play leans against an inner chamber surface and during gliding along the inner chamber surface the sealing section in respect of the inner chamber surface remains in the same position through toppling around its length-axis. During pressure differences on both sides of the rib, the cylindrical rod will seal off the play between rib and inner chamber surface.
When reaching and passing of a free angle of the square inner area, the sealing element can be toppled with the aid of a suitable shape of the free angle or by special conduction strokes in the free angle (18), over an angle until a suitable starting position for the gliding of the flat stroke along the next inner surface.

Execution and working of the play sealing A3 (fig.2,detail A3).
Each cylindrical rib of the rotary piston is over the full length and the full breadth replaced by a radial groove in longitudinal direction (19).
In that groove fits a radial movable sealing element of the same length, which, towards the exterior facing side in longitudinal direction, has the form of a cylindrical surface of 60°, with the radius of a rib-cylinder (20).
This sealing element is being pushed to the exterior with the aid of spring pressure and/or centrifugal force, so that during passing of an inner chamber surface the sealing element touches along the contact straights of the cylindrical surface.
When a pressure difference on both sides of the rib occurs, the sealing element is pushed against a side wall of the groove and is held tightly in this position until the pressu-

re difference falls off.

Fig.3 shows a cross section and a longitudinal section of a technical construction according to items mentioned up till now. The central shaft (3) has bearings (12a) in the side parts (11); the rotary piston (2) has bearings on the eccentric (4).
On the rotary piston a gear wheel (8a) is fitted of which the centre coincides with the centre axis of the rotary piston. This gear wheel is meshing a ring gear wheel (8b) with internal gearing, which is firmly connected with the square housing and of which the centre coincides with the longitudinal central axis of the square housing.
When the rotary piston makes 1/3 revolutions, the gear wheel runs completely through the internal gearing, which means that the proportion of the gear wheels is 3 : 4.

The flanks of the rotary piston will roll during the rotation of the rotary piston in the square inner area along the inner chamber surface in a direction opposite to the direction of rotation of the rotary piston and at the same time to a relative small extent slide along the inner chamber surface in a direction which corresponds with the rotation direction of the rotary piston.
For the roll and slide purposes, plays have to be kept to by the construction of the machine between its flanks and the inner area surface.
With certain applications of this rotary piston, the plays can manifest themselves as sealing defects between two working chambers and have a disadvantageous influence on the intended working of the machine. In order to stop or limit this disadvantageous influence, the flanks can be provided with a co-operating system of flank play sealings.
A flank play sealing consist in principle of a radial groove (27), made in the flank in longitudinal direction of the rotary piston, (see fig.5).
Over the full length of such a groove there is a sealing element (28), which by spring pressure (29) stretches up till outside the surface of the flank. When the flanks are rolling

and gliding, other parts of the flanks will always touch the inner chamber surface. As soon as the sealing element touches the inner chamber surface, the element will consequently be pushed against the spring pressure deeper into the groove and following under pressure give temporarily support to the sealing between the two working chambers on both sides of the imaginary contact straights of the flank with the inner chamber surface. With a co-ordinating system of flank play sealings, a number of this grooves with sealings must be fixed in one flank on at least such distance among each other, that during off-rolling of the flank along an inner chamber surface, constant at least one of the sealing elements must be operational.

For more details see aforesaid Euro-patent application.

Rotary Piston Machine according the invention.

The invention partly refers to the rotary piston machine of the preceding summary.
Therein is paid much attention at internal play sealings of the rotary piston machine.
Also at the rotary piston machine of this invention there's paid much attention at the internal play sealings.
By which the research was partly directed to the aforesaid Euro-patent application, specially to the play sealings A1, A2, and A3:
Play sealing A1 departs from a cylindrical metallic bar, laying loosely in a guttershaped groove.
Play sealing A2 departs from a thickened cylindrical bar with a levelling, laying loosely in a cylindrical groove.
Play sealing A3 departs from a sealing plate, laying loosely and radial movable in a right angled groove.
Although the universal usable machine design under changing circumstances with these play sealings surely can prove its usefulness, there are disadvantages coupled to the loosely laying of the sealing elements.
Particularly at the passing of the free angles, which have an appropriate composition or are provided for special conductionstrokes, through which the sealing elements are being kept at their positions in the respectively grooves and/or toppled, appear relatively large centrifugal forces.
These centrifugal forces make, that the sealing elements are being pressed against the cylindrical inner surfaces and because of that create extra friction losses, wear and motor noise.
The invention intends among other things to solve this difficulties.

Because neutralization of the centrifugal forces at the play sealings A1 and A3 is not quite possible for constructional reasons, the research was for the greater part focused at the play sealing A2, see fig. 5, relative scale about 5 : 1, that means in relation to fig. 7.

The cylindrical metallic bar (40) with levelling (44) (from here on in cross sections called chord and representative for the breadth of the levelling) is able to turn around in his cylindrical housing (32) at the position of a rib-cylinder of the rotary piston.
In the axis of the sealing element is on each end a bore (33) put in, in which with a small play a cylindrical plug (34) can be placed which part is of a link that consists of two of such cylindrical plugs, connected by a bridge.
The second plug of the link can be placed precisely in a bore (36) in the body of the rotary piston (37).
On placing the link in the whole, the bridge partly will be taken up by a space (38) in the body of the rotary piston and in a lower part (39) of the end of the sealing element, in such a way that the upper side of the link lays in the same surface as the side surface of the rotary piston and the end of the cylindrical sealing element.
The lower part in the end of a sealing element is of such shape that the sealing element from the drawn position can turn about 30 degrees to the right as well to the left.
So is achieved that the levelling of the cylindrical sealing element in all positions of the rotary piston can lean flat against the inner chamber surfaces of the square inner area, and, after some supplies, also the cylindrical inner surfaces of the square inner area can follow fluently, while centrifugal forces are cancelled out by the bridges in both the ends of the sealing element.
Because at the passing of an angle of the square inner area the touching straights of the cylindrical rib are following an imaginary inner cylindrical surface of 90 degrees, with a length of the radius equal to the length of a leg of the free angle, is for the play sealings A1 and A3 as the best shape of a free angle to applicate an inner cylindrical surface precisely fitting in that free angle. So that the inner surface of the four in square relation positioned flat inner surfaces, together with the inner surfaces of the four cylindrical inner surfaces, in cross section forms a symmetrical and fluently closed curve with four axes of symmetry.
However, fig. 6 offers a new planimetrical construction of a

cross section of a free angle, specially designed for a sealing element according the play sealing A2.
Starting from the right on top of the drawing given cross section of a sealing element according play sealing A2 (40) (relative scale about 7,5 : 1), one let follow the centre of the angle circle (rib cylinder) (41) through the right down drawn free angle (42) an arc of a circle of 90 degrees (43), of which the centre falls together with the centre M of the imaginary and precisely in the free angle fitting arc of a circle of 90 degrees, (45a).
In a number of points devided along that arc of a circle one can draw angle circles, with connected in the right positions the chords, being representative for the breadth of the levellings (44).
Further one can draw a fluent curve (45) trough all the ends of the chords, what then appears to be an arc of a circle of more than 90 degrees, with a radius which is larger than a leg of the free angle, but with also the centre laying in M.
This larger arc of a circle connects at both his ends discontinue to the projections of the adjoining inner surfaces, so that these inner surfaces at both ends are shortened with half a chord, as in the drawing directly is to be seen.
That means that a cross section of the square housing the continuous inner surfaces exposes with totally 8 discontinuities, see fig. 7, (46).
These 8 discontinuities do not mean that as much of them act in the movements of the circulating sealing elements.
On the contrary; with neutralized centrifugal forces the sealing elements are gliding in fluent movements along the flat and the cylindrical inner surfaces, with minimal friction losses, wear and machine noise.
Fig. 7 shows a principal view/cross section of a rotary piston with sealing elements according the system of thickened rib cylinders with levelling and centrifugal force neutralization, positioned in a square housing with continuous inner surfaces with 8 discontinuities (46), (relative scale 1 : 1).

Fig. 8 shows a principal view at a rib of a rotary piston with a sealing element passing a flat inner surface, precise-

ly half way that surface,(relative scale about 7,5 : 1). Left and right of the levelling gliding strips are applied (47) which due to their shapes and position can lay suitable against a cylindrical inner surface, so that the levelling in cross section forms the chord and by which these gliding strips have the intention when passing a cylindrical inner surface to contribute to the whole of internal sealing, but also to topple the levelling 90 degrees (relative to the square housing) through a fluently gliding metallic contact. The thickened sealing cylinder is therefore provided with an extra thickening (48), by which the thickness depends of the choice of the machine constructor.

Fig.9 shows a principal view at a rib of the rotary piston with sealing element, when passing a cylindrical inner surface, explaining clearly the functions of the gliding strips (relative scale about 7,5 : 1).

Fig. 10 shows a principal view at a rotary piston rib with sealing element, turning to the right when passing a discontinue connection from a flat inner surface to a cylindrical inner surface, precisely on the moment when the toppling begins.
This clearly illustrates the continuous fluent movement of the sealing elements.
If the rotary piston would turn to the left, then the sealing element would reach just the end of its toppling, (relative scale 7,5 : 1).

The figures 8, 9, and 10 also show how a sealing element, free from centrifugal forces, at pressure difference between both sides will topple around it's central axis, so the play between levelling and inner surface will automatically close off.

Name the radius of the larger cylindrical inner surface = Svcb.
Name the number of degrees of the larger arc of a circle= Agvc
Name the shortening of a flat inner surface = Bvbm
Name the excentricity of the machine = r
Name the constant width of the rotary piston = R
Name the diameter of a rib cylinder = D
Name a leg of a free angle = V.H.
Name a chord of a sealing element in cross section = K
than you can write next deductions:

$r = 0{,}07735 \times (R - D)$

$V.H. = 0{,}134\ R + 0{,}366\ D$

$Svcb = \sqrt{ (0{,}134\ R + 0{,}366\ D)^2 + 0{,}25\ K^2 }$

$Agvc = 90 \text{ degrees} + 2 \operatorname{arctg} (0{,}5\ K / V.H.)$

$Bvbm = 2 \times 0{,}5\ K$

what means that r, R, D, V.H. and K have mutually exact relations and no random can be accepted at designing these machines.

These rotary piston machines are in practice universal applicable. One can design these machines for pumping fluids, but one can design these machines also as motor for the use of fluids under pressure.

It's possible to design machines for bringing gasses under pressure, but also with gasses under pressure one can applicate these machines as motor.

One can design combustion engines, two strokes or four strokes, always with four cylinders or multiples of four cylinders.

One can build small machines or big ones; low speed engines or high speed engines; lower temperatures or higher temperatures; the rotary piston machine according to the invention is usabel, for all these applications, and will particularly attract attention by its noisless and vibrationless working. But also its specific fuel consumption and its power in relation to its own weight are competitive, because of its direct and exact rotation, with large allowable plays and possible high numbers of revolutions.

Claims.

Claim 1.

The rotary piston machine according to the invention is of the type that consists of an enclosing body with four flat inner surfaces, forming an in cross section square inner area and four in the free angles of the square inner area positioned inner cylindrical surfaces of 90 degrees, with radii of which the length is equal to the length of a leg of a free angle, and side parts, which together enclose an inner area of which the inscribed cylinder has the diameter R and whereby through the longitudinal central axis of the inner area in at least one of the side parts a shaft bearing, with eccentric is positioned around which a rotary piston is placed, of a length, equal to that of the inner area and which in cross section has the perimeter of a fluently closed curve of constant width R, with 3 axes of symmetry, by which in respect of the power activities through both parallel axes of the rotary piston at least one system of two meshing gear wheels has been fitted, of which one gear wheel with internal gearing and one gear wheel with external gearing , so that during rotation of the axis with eccentric parts of the rotary piston glide along the inner area surfaces, whereby between rotary piston and free angles of the square inner area four separated one from the other and in volume changing working chambers are being formed, and which during rotation of the rotary piston around its centre axis pass through cyclic volume changes and whereby each rib cylinder, for improvement of the gas tight or liquid tight separation of both adjacent working chambers is substituted by a movable cylindrical sealing element of bigger diameter than the rib cylinder, which on the inside out turned side is provided with a levelling over the entire length and to a depth by which the levelling touches at the imaginary rib cylinder, so that positioned at its exact place in the rotary piston the levelling over its entire length can glide along a flat inner surface and in case of pressure difference the play between rib and inner surface can close off, characterised in that for the gliding of a sealing element along a cylindrical inner surfa-

ce, in the cross section of the square inner area in each angle the arc of a circle of 90 degrees is substituted by an arc of a circle of more than 90 degrees and with a longer radius, drawn from the same centre.

Claim 2.

Rotary piston machine as claimed in claim 1, characterised in that parts of an enlarged arc of a circle are located outside the free angle.

Claim 3.

Rotary piston machine as claimed in claims 1 and 2, characterised in that in cross section each end of an enlarged arc of a circle discontinue connects to the cross section of an adjacent flat inner surface, in such a way that the flat inner surfaces are being shortened on both sides with half the breadth of the levelling of a sealing elememt.

Claim 4.

Rotary piston machine as claimed in claims 1, 2 and 3, characterised in that in spite of the 8 discontinuities in the cross section of the square inner area each sealing element, at rotating rotary piston, follows an all round fluent path.

Claim 5.

Rotary piston machine as claimed in claims 1, 2, 3 and 4, characterised in that each sealing element on both sides of the levelling is provided with gliding strips, which qua shape and positioning can lay parallel against a cylindrical inner surface, so that in cross section the levelling forms a chord and by which these gliding strips are intended, at passing a cylindrical inner surface, to contribute to the internal sealing, but also to topple the levelling 90 degrees through the gliding and fluent metallic contact with the cylindrical inner surface.

Claim 6.

Rotary piston machine as claimed in the claims 1,2,3,4 and 5, characterised in that each sealing element mechanically is

connected with the body of the rotary piston in such a way, that the sealing element against centrifugal forces is being hold in its place in the rotary piston, while also is staying unhampered the possibility of the sealing element to turn around it's longitudinal axis over an angle of about 60 degrees.

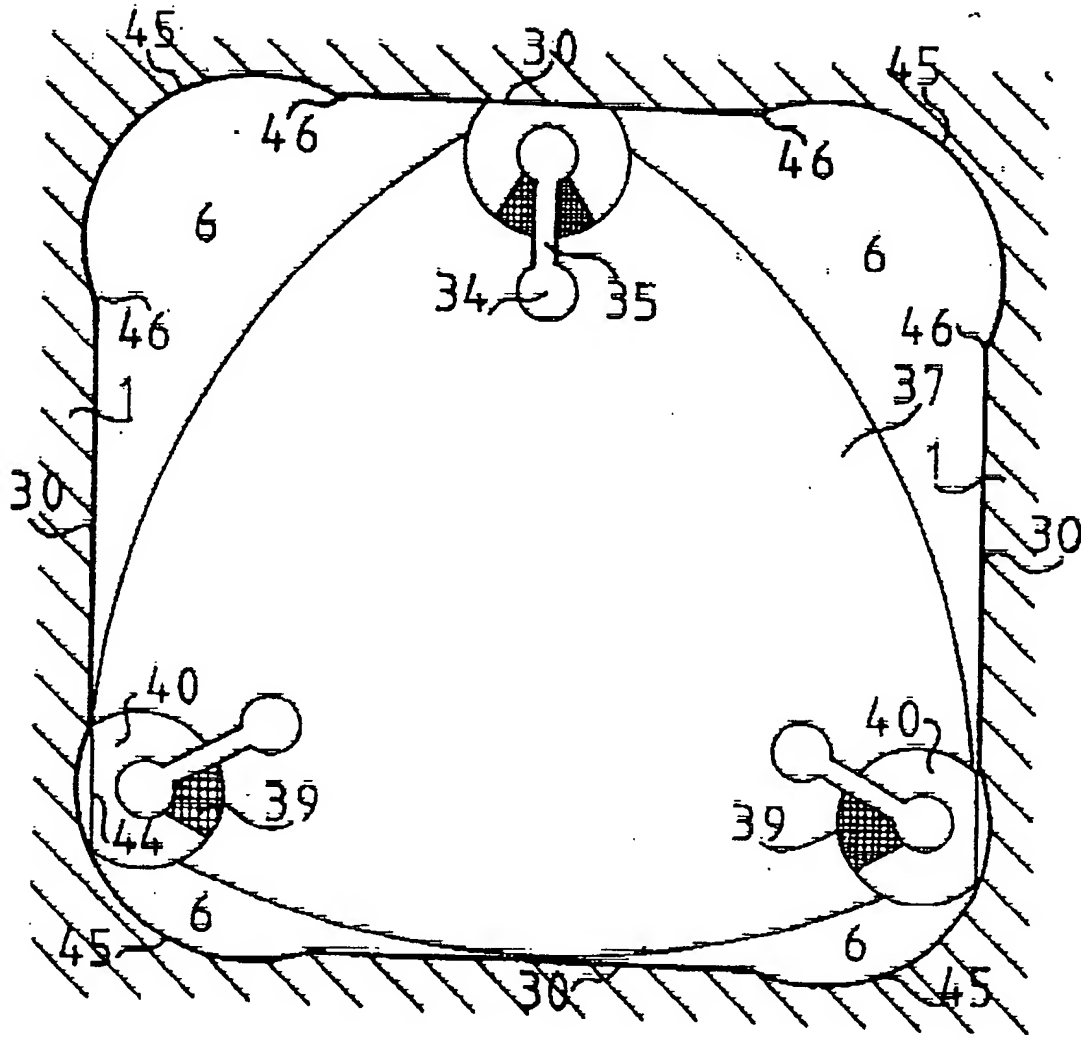
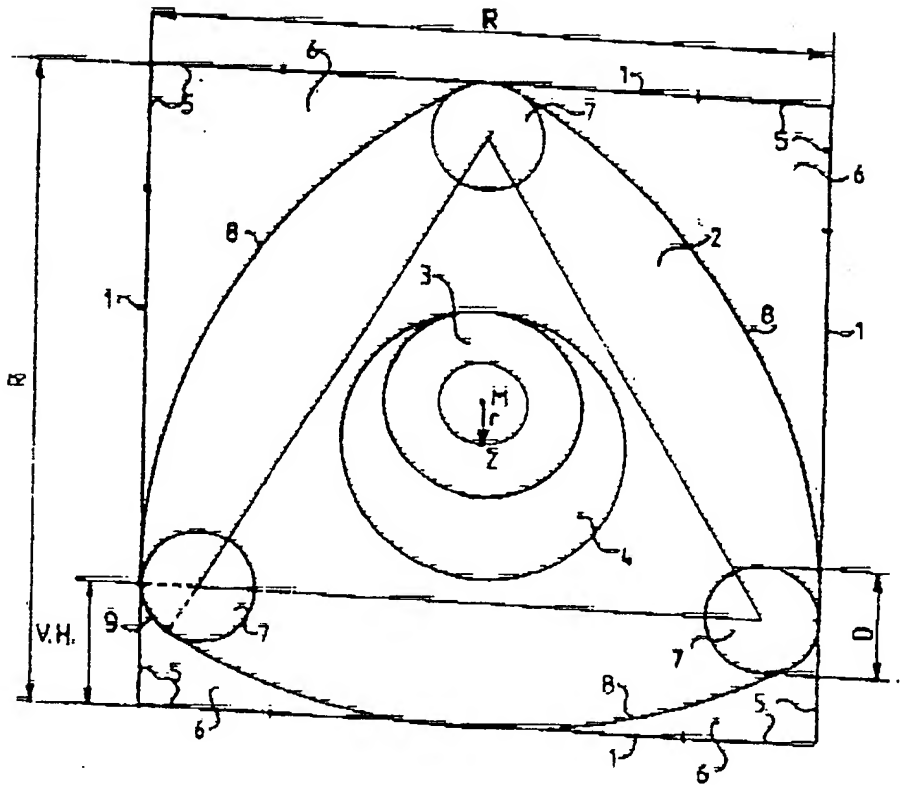


FIG. 0



$r = 0,07735 \times (R - D)$

$V.H. = 0,134\ R + 0,366\ D$

FIG.1

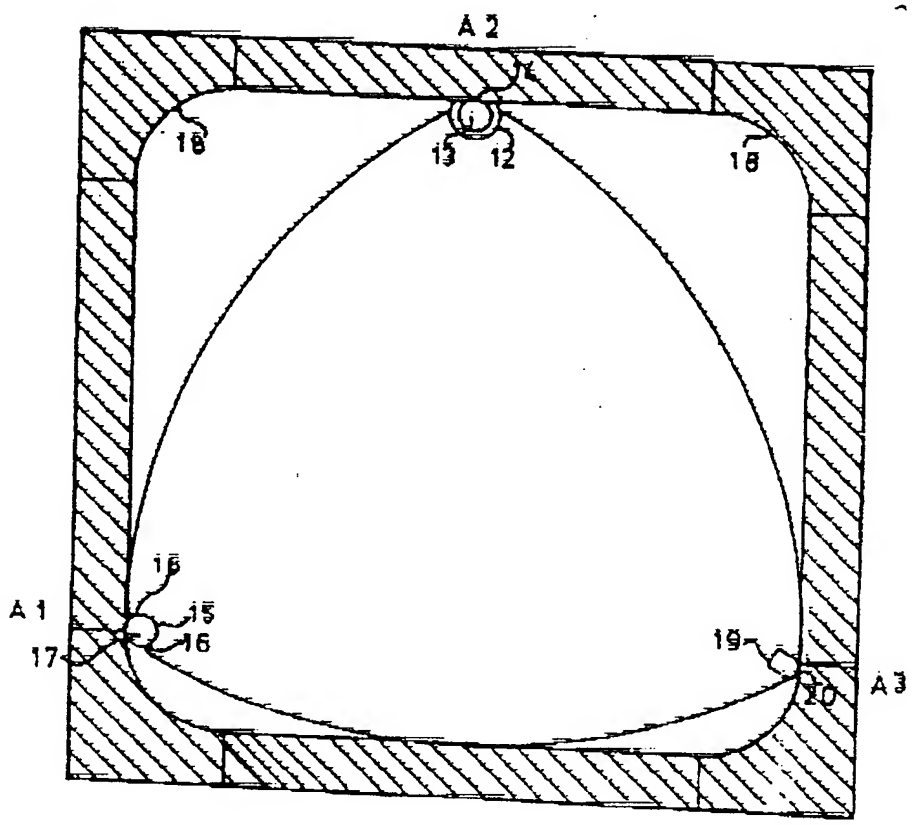
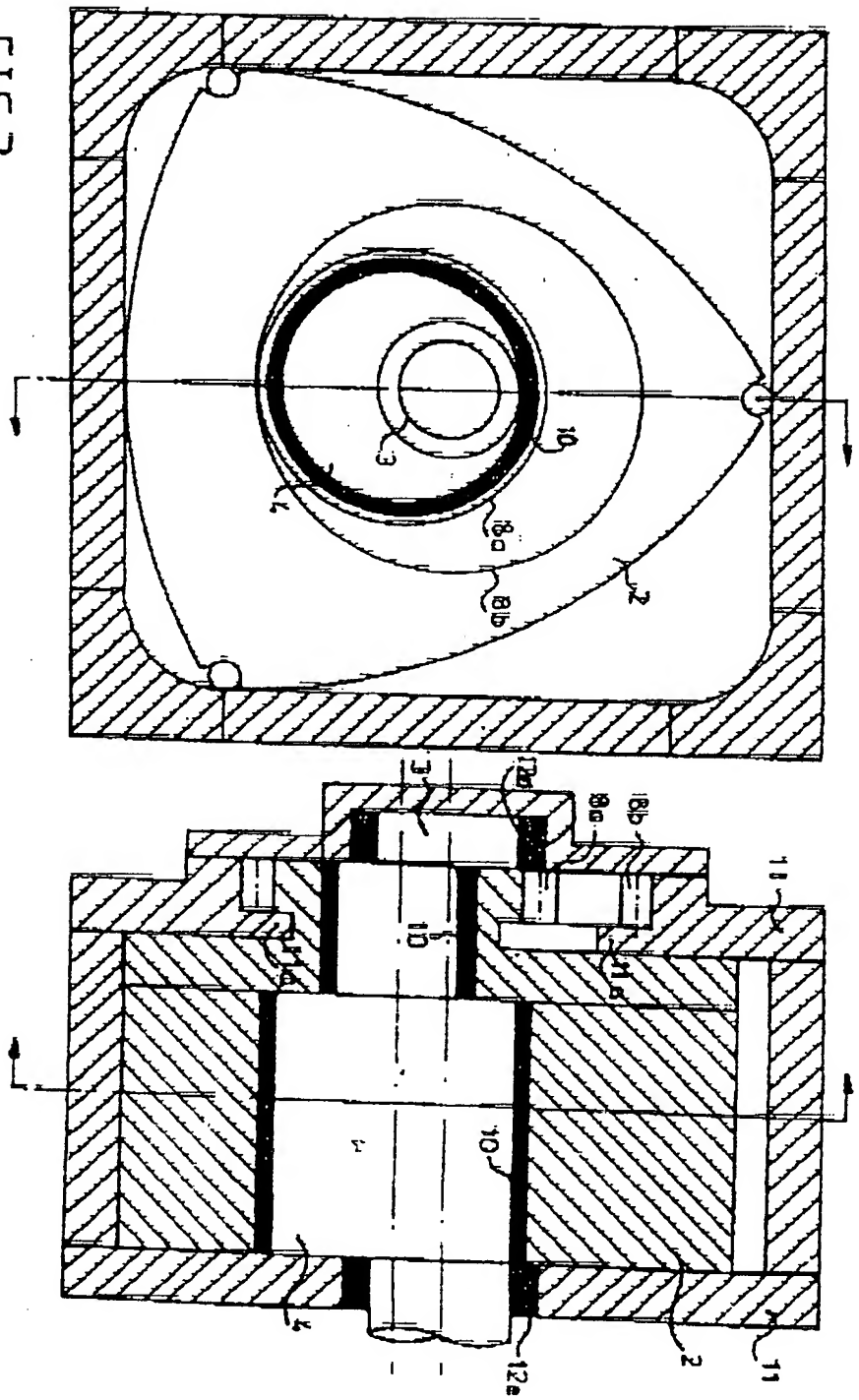


FIG. 2

FIG.3



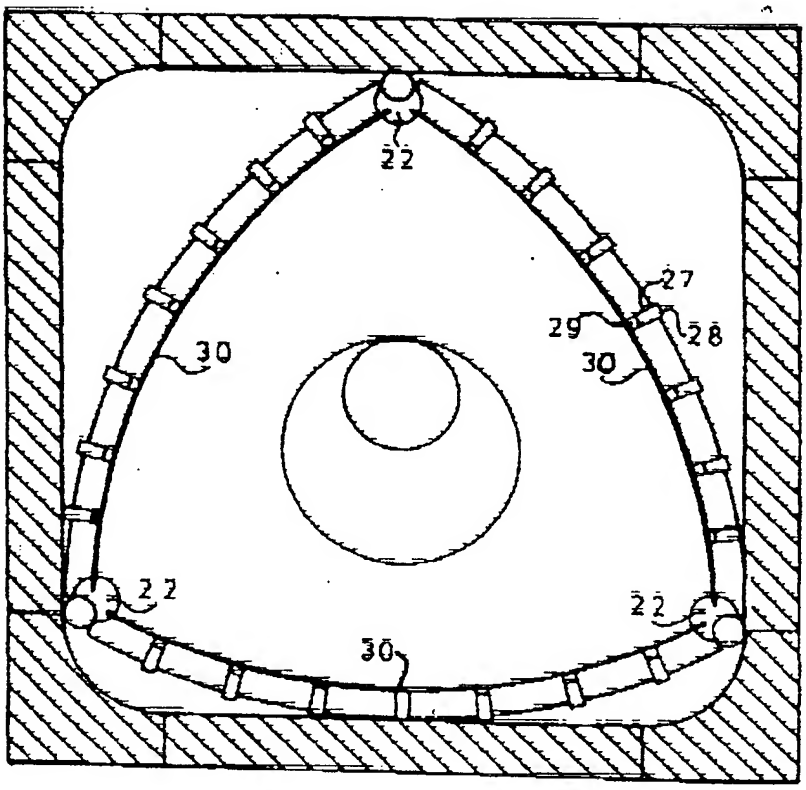
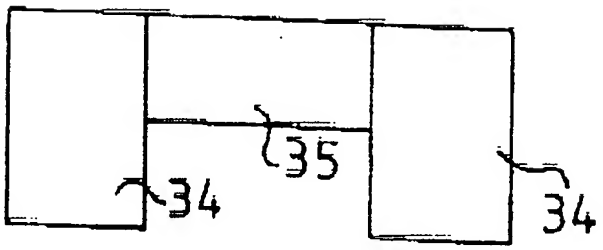


FIG. 4



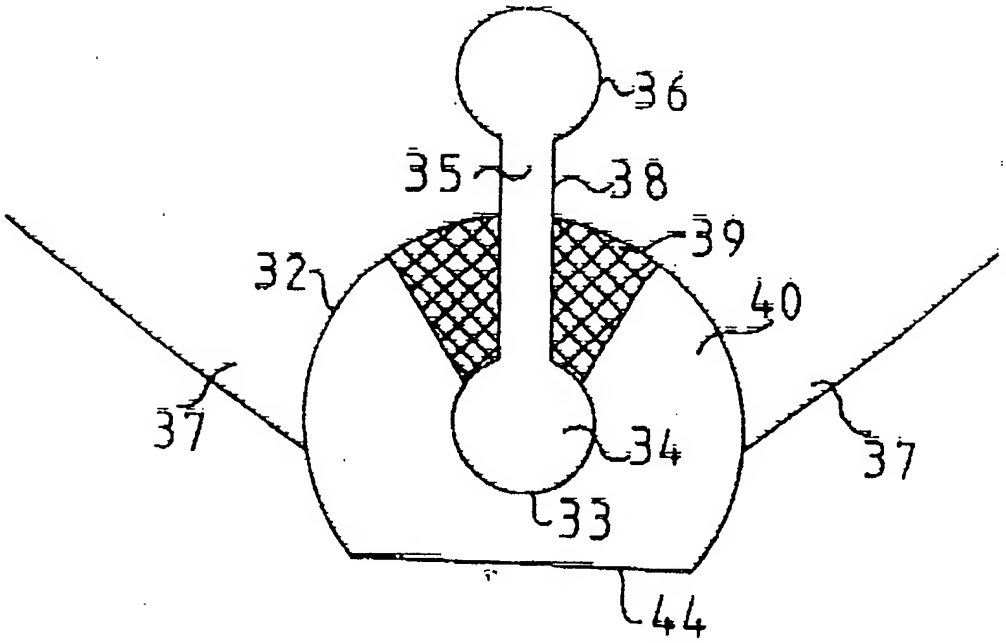


FIG. 5

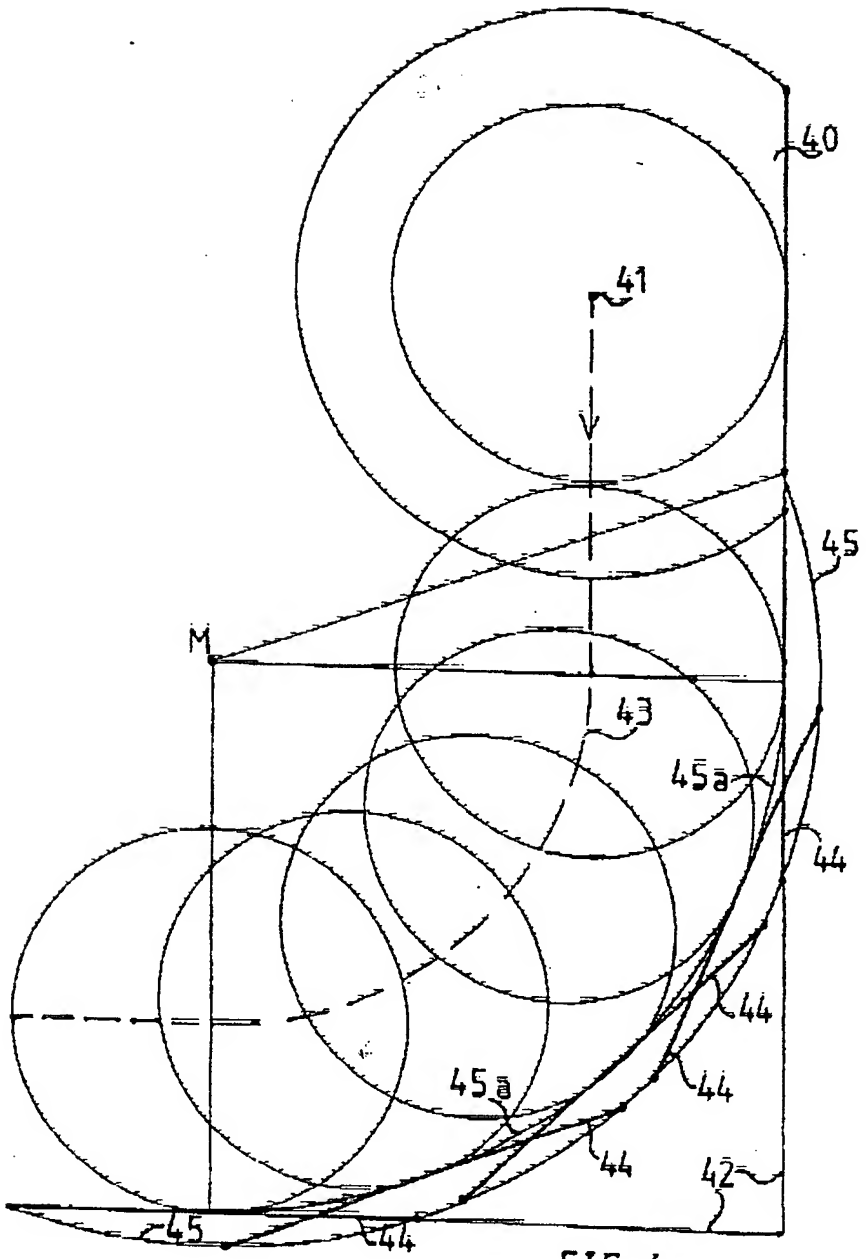


FIG. 6

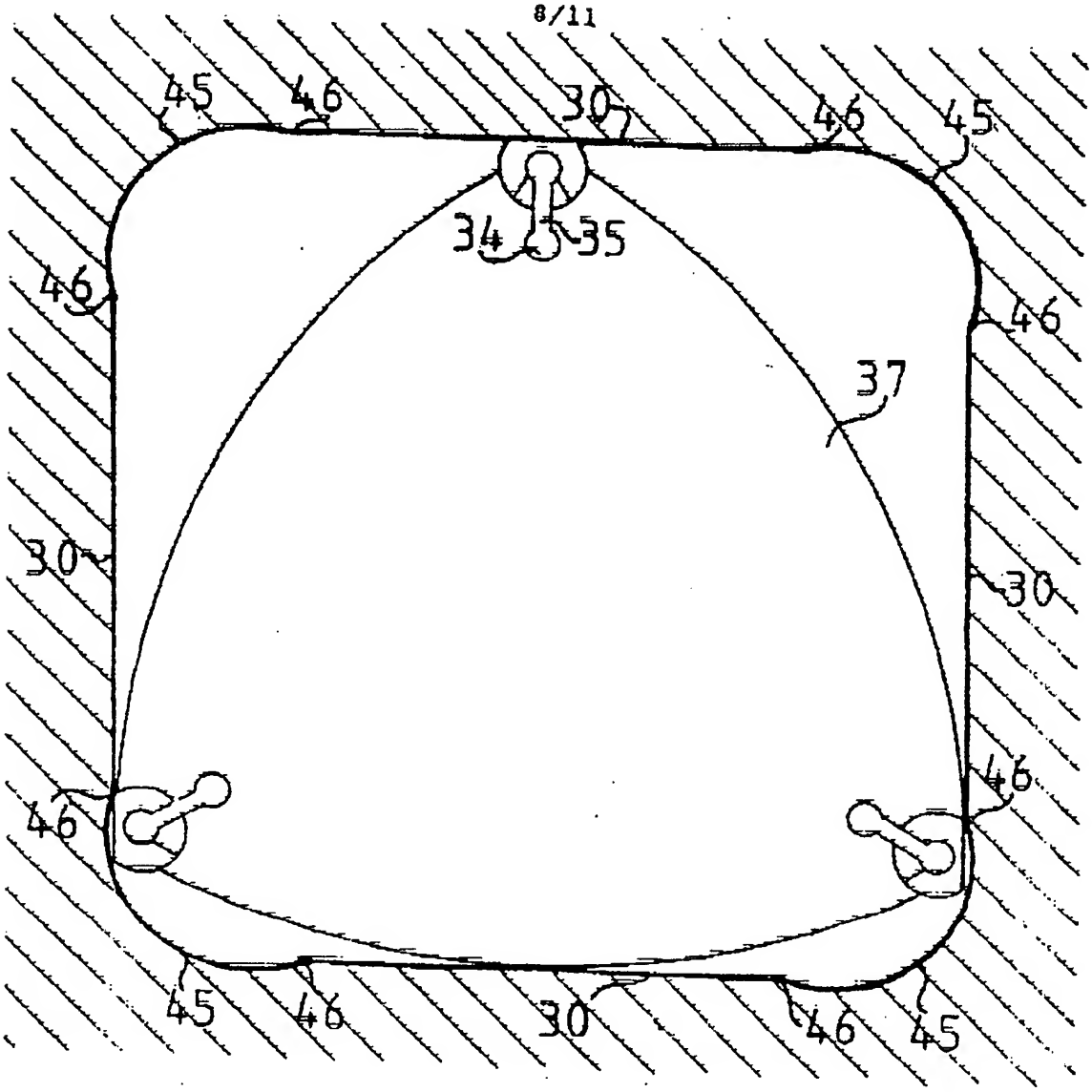


FIG.7

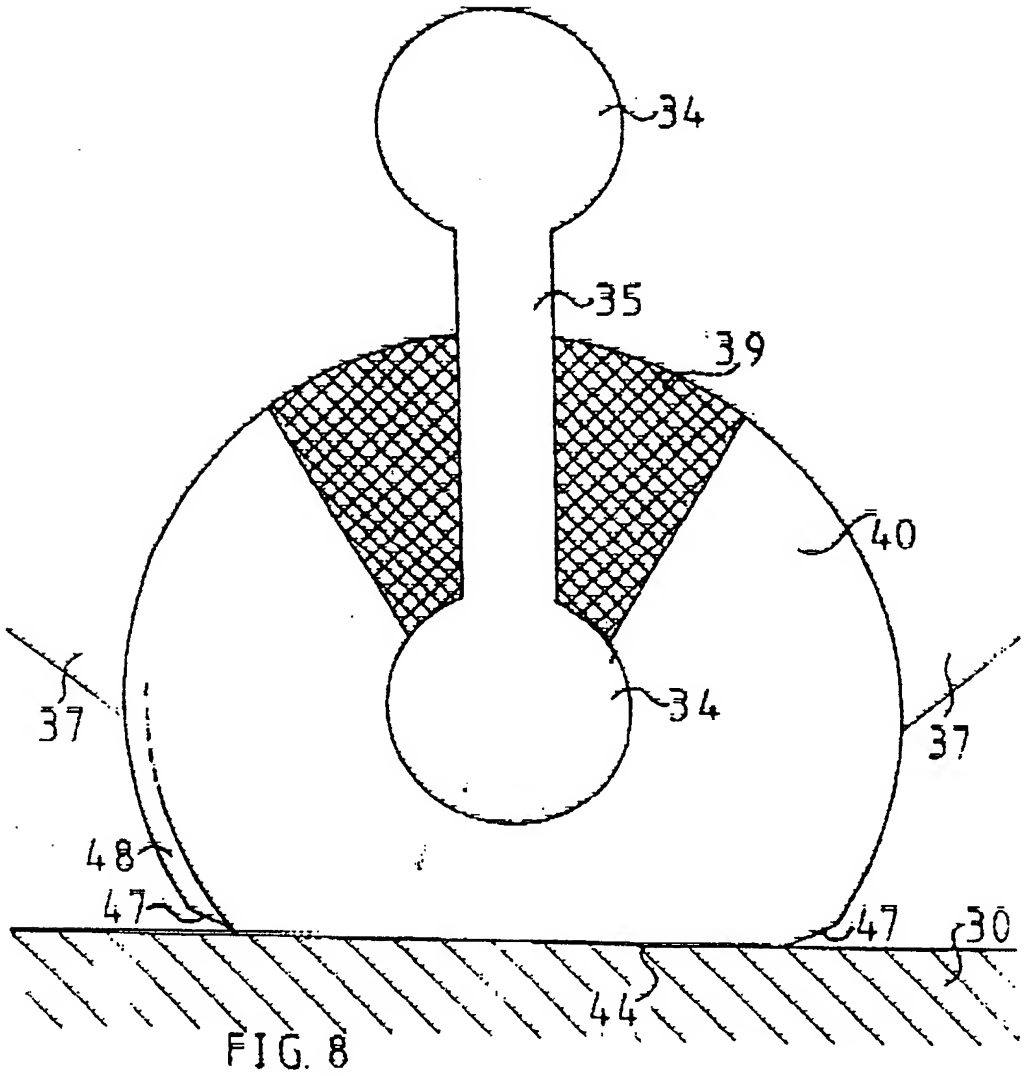


FIG. 8

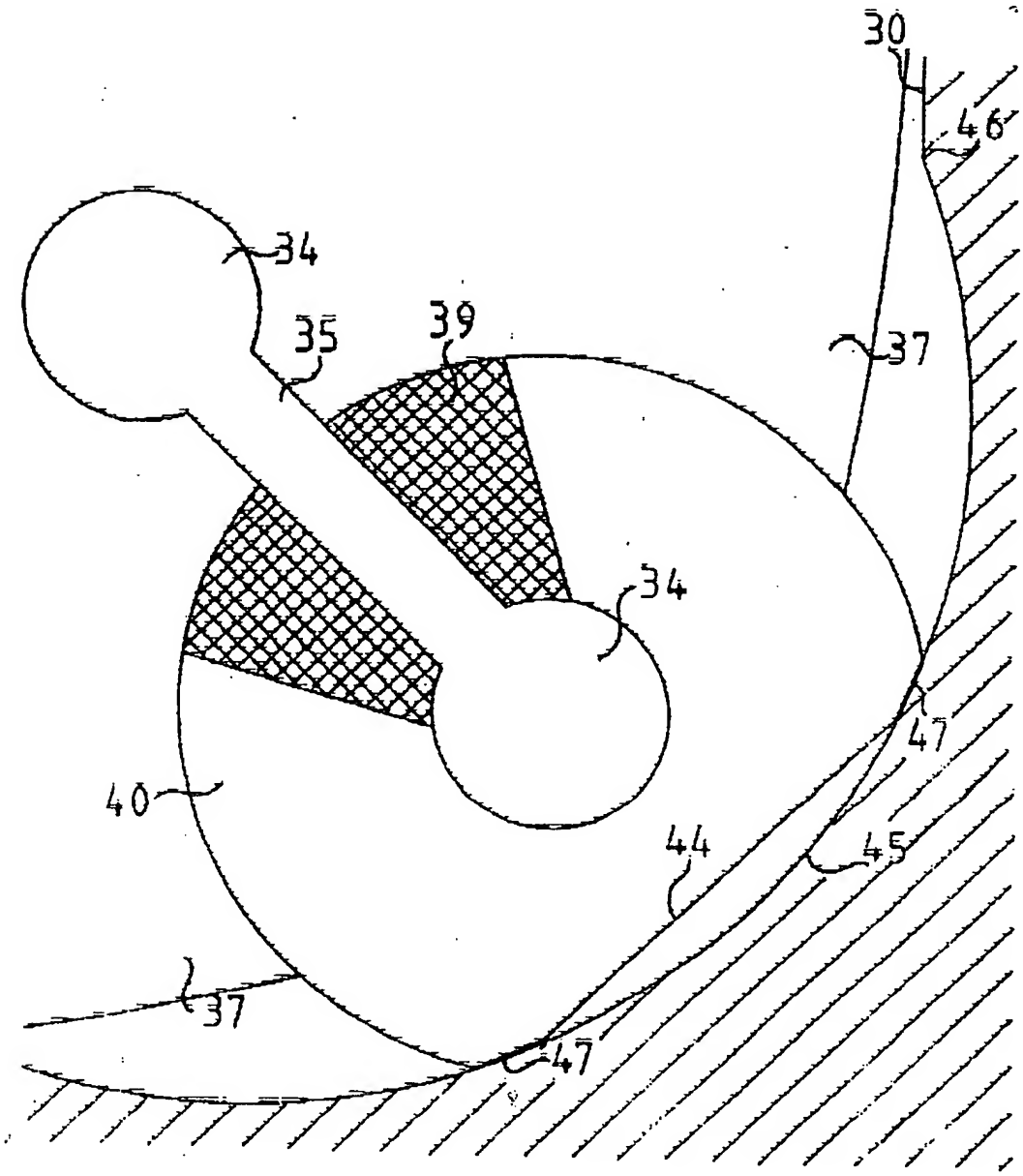


FIG. 9

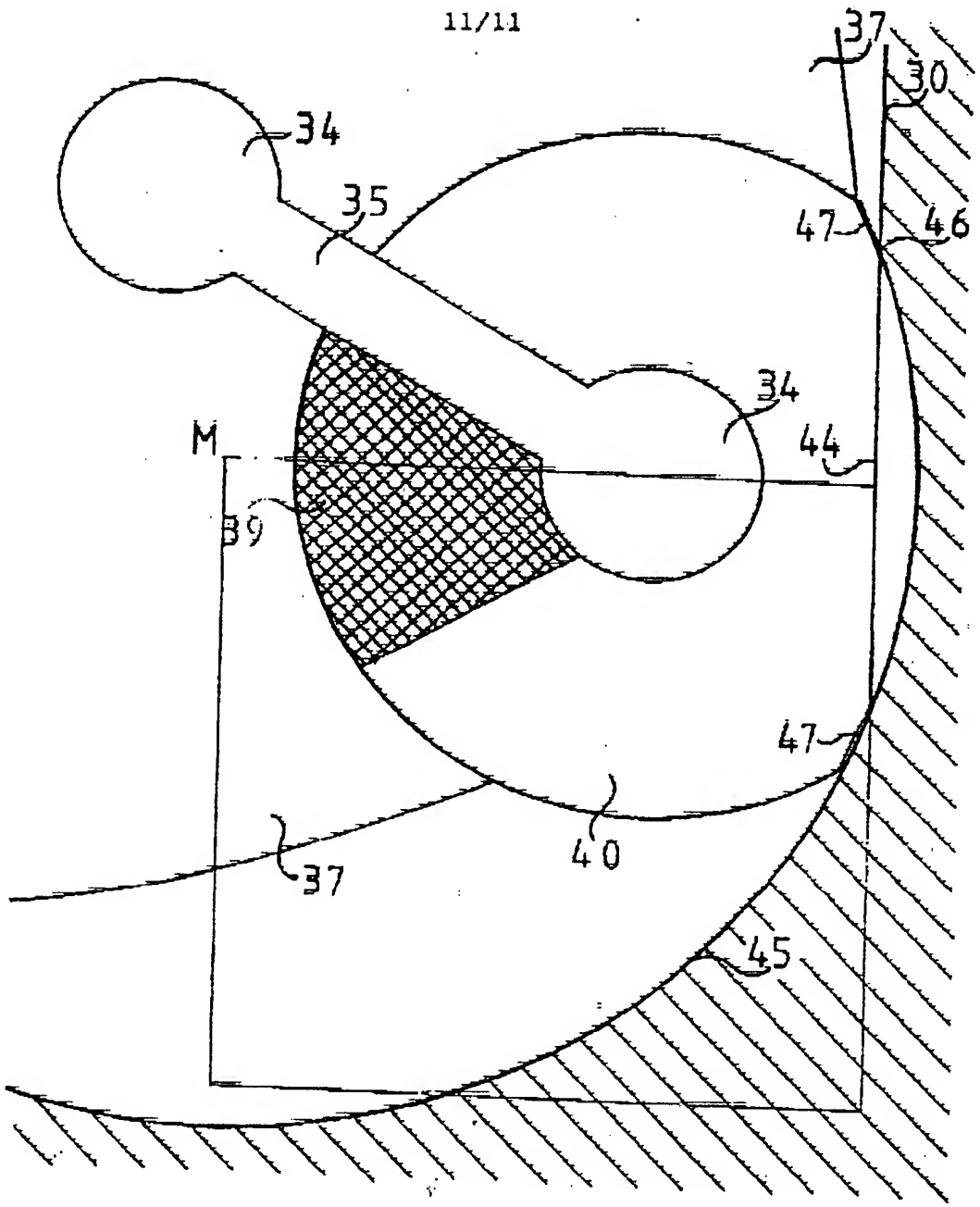


FIG. 10

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 F02B53/00 F01C1/10 F01C19/04	tional Application No PCT/NL 98/00223

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F02B F01C F01B F04C

Documentation searched other than minimumdocumentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95 12053 A (DE GEUS) 4 May 1995 cited in the application see the whole document	1
Y A	DE 25 04 285 B (KLOSA) 20 May 1976 see column 2, line 58 - column 4, line 9; figures 1,2	1 2,3,5
A	DE 23 19 475 A (WELT) 31 October 1973 see page 5, paragraph 5 - page 6, paragraph 1; claim 9; figures 8-10,14	6
A	US 3 034 484 A (STEFANCIN) 15 May 1962 see column 4, line 43 - column 5, line 73; figures 3,7	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publicationdate of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 July 1998	21/07/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Wassenaar, G

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INTERNATIONAL SEARCH REPORT

Information on patent family members

ational Application No
PCT/NL 98/00223

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9512053	A	04-05-1995	NL 9301867 A		16-05-1995
			EP 0745177 A		04-12-1996
DE 2504285	B	20-05-1976	NONE		
DE 2319475	A	31-10-1973	CA 958647 A		03-12-1974
			US 3926538 A		16-12-1975
US 3034484	A	15-05-1962	NONE		